shaped pieces of leather or rubber riveted upon it at intervals, so as to adapt it for running in the grooved pulleys, as shown in our engravings.

Obviously the most important problem presented by this arrangement is the great variation in the speed of the dynamo, and in the voltage generated. There is also the necessity of lighting the car when it is not in motion. Railway cars run at any speed between ten and sixty miles an hour, and as the armature is driven directly from the axle, the speed of the latter will vary directly as the speed of the train. For reasons which are well understood, the voltage generated increases with the speed of the armature, and hence it is evident that if the constant electric voltage which is necessary at the lamps in electric lighting is to be secured, some kind of regulation of voltage or pressure must be provided. Moreover, as the car may run in either direction, provision has to be made for maintaining the current in a constant direction. Furthermore, as there will be times when the dynamo is not running at all, but when it will be necessary that the lamps shall remain lighted, there is a necessity for storing up the surplus current generated while the dynamo is in motion and yielding it when it is needed. Such an agency is found in the ordinary storage battery. Various means of regulating the voltage have been adopted. One method that has been attempted is to allow the belt to slip as the speed increases; but the impossibility of finding any means of automatically adjusting this slippage has rendered such a device impracticable. Another attempt at regulation is that known as the differential field winding, which is so arranged that as the magnetism due to the shunt winding increases with the speed of the train, the demagnetism caused by the reverse series winding comes into action, the result being a nearly constant pressure.

The Consolidated Railway Electric Lighting and Equipment Company has proceeded on the lines followed by the great electric lighting companies in the matter of regulating the pressure. Constant pressure is maintained by cutting out resistance in the field windings, shunt-wound machines being employed. Thus, if the current increases and the pressure falls, resistance is cut out of the field windings, necessitating a greater flow of current through the field, the effect of which is to increase field magnetism and, therefore, the pressure. On the other hand, if the pressure rises, resistance is cut into the field winding, and the field magnetism and therefore the current pressure is reduced. This system of control is operated automatically by means of a "Regulator" which contains a motor operating in connection with a rheostat and a double pawl and gear movement. The result is an absolute protection against the burning out of lamps or the overcharging of the battery.

In any system of electric lighting from the axle the problem of a proper drive from axle of car to shaft of armature is necessarily a serious one. Attempts have been made to overcome the many and obvious objections to a belt drive by substituting, first, a gear drive, which was found to be unsuitable on account of the extreme vibration set up, and then a friction drive which, because of the vertical motion of the axle, led to heavy pounding of the driving pulley against the driven pulley and an ultimate fracture of the armature shaft. In the gear which forms the subject of the illustration, the difficulty is overcome by combining the positive action of the gears with the flexibility of a belt transmission. The flexible gear consists of a suitably armored belt with V-shaped segments arranged on its inner side, so as to permit the use of a hollow pulley. With this belt, curves of a very short radius may be rounded without the belt slipping off.

Storage batteries are provided for the purposes of storing up the surplus current and yielding it again when the dynamo is running below its whole output, or not running at all. Thus, in the day time, the full output of the dynamo passes into the batteries, and is stored. This current is available when the train is standing on a siding or at a station, or when the speed of the train is so small as not to yield the current needed for the lamps and fans.

The results obtained with the overland train on the Sante Fe Railroad are stated to have been highly satisfactory, a decided gain being shown, especially when the superior nature of the illumination over that afforded by the ordinary gas system is taken into account. The weight of the installation on each car is less than 2,000 pounds, a very insignificant percentage of the total weight of a modern Pullman coach. Apart from the first cost, the expense attached to this system is exceedingly light, the flexible gear, in spite of the extremely severe duty imposed upon it, giving efficient wear for a period of six months, and the repairs to the electrical equipment, although the dynamo runs at a speed of over 2,000 revolutions a minute, have proved to be very light.

THE LOOMIS GASOLINE RUNABOUT.

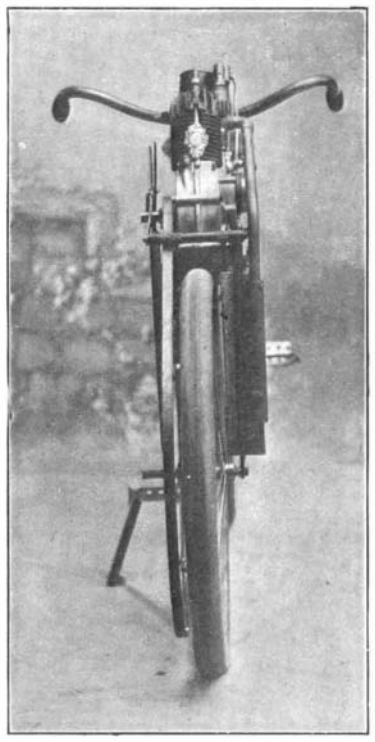
RECENT GASOLINE AUTOMOBILES.

The automobiles on view at the Cycle and Automobile Show in Madison Square Garden, of this city, last week, although comparatively few in number, were yet of considerable interest, and in but a few cases were they a repetition of exhibits of the previous shows.

The Loomis Automobile Company, of Westfield, Mass., exhibited two runabouts which are a great improvement over the one shown last year as far as propelling power is concerned. These carriages, which are built with and without a box behind (the box being in this case so much spare space for carrying packages), are equipped with an air cooled Crest duplex nominal five horse power gasoline motor, neatly arranged on the running gear. The running gear is triangular in shape, and is made of a double frame of steel tubing horizontally pivoted to the front axle at the apex of the triangle. The Upton countershaft is used between the motor and the rear axle. This device permits two speeds ahead of five and fifteen miles per hour and one slow reverse. A chain drive is employed throughout. The steering arrangement of this vehicle is a newly patented device. The handle shown beside the seat, in the same position as the throttle of most steam carriages, is moved slightly back and forth to steer in either direction. The lever is pivoted on the under side of the carriage body and attached to a rocker which shifts the steering arm of the wheel by means of a rod connection. The universal ball joint generally used between the steering arm of the wheel and the lever on the carriage is dispensed with, and the arrangement of the handle, besides giving twice the leverage generally to be had, is such that access to the seat is unimpeded.

The Loomis runabout we illustrate was frequently seen running in the basement of the Garden, and it climbed the rather steep incline from the basement to the main floor. It is equipped with mufflers of a new design which effectually deaden the exhaust, and also with a novel carbureter, which we shall illustrate later.

Other gasoline vehicles noted at the show were the "Trimoto" of the American Bicycle Company, the "Warwick," and the "Rambler." We hope to illustrate these in a later issue.



FRONT VIEW, SHOWING MOTOR, DRIVING BELT AND PULLEY ON FRONT WHEEL.

MOTOR-CYCLE WITH MOTOR CARRIED ON FRONT FORKS AND DRIVING FRONT WHEEL.

THE ANNUAL BICYCLE SHOW AT MADISON SQUARE GARDEN.

The first impression made upon a visitor to the bicycle exhibition at Madison Square Garden was that the bicycle as such has unquestionably reached its final type. There is less difference between the wheel of 1901 and the wheel of 1900 than between those of any other successive years in the history of the bicycle. But having said this, it must be admitted that there is a marked improvement in the details and finish of many of the machines; and during a tour of the exhibits, we failed to find a single machine that exhibited roughness and clumsiness of design or carelessness in finish.

The chainless bicycle is evidently gaining in favor, if we judge from the proportion of this type that are on exhibition. Both the outside and inside drive are in evidence, the former being the type which was identified so largely with the Columbia bicycle, and the latter with the Spalding wheel. The price has come down, as was predicted, until it approaches that of the ordinary chain-driven machine.

The coaster brake has won its way in popular favor, until now every company is prepared to furnish it, as an extra, with new bicycles. Apart from its convenience in coasting, it has the value of affording an absolutely reliable and extremely powerful emergency brake, as well as one that may be applied with any desired amount of pressure.

Another invention designed for increasing the comfort of riding is the well-known cushion frame, which may be purchased in preference to the rigid frame from most of the leading makers. Perhaps the most noticeable departure of the year, because of its conspicuous position on the machine, is the extension handle bar, which owes its existence to the present tendency to narrow the wheel base of the bicycle. This shortening of the wheel base brings the seat so near to the head of the machine that it is necessary to carry the handle bars on an extension in order to clear the knees of the rider. The change—it can scarcely be called an improvement—was introduced by the riders in paced races, and it is not likely that it will find very much use among the average road riders. Indeed, the roadster machines, in which class is included the vast majority, will still have the old wheel base of 44 inches.

Several designs of motor bicycles were shown at the exhibition, in most of which the motor is carried within the frame and either belted to a pulley attached to the side of the rear wheel, or fitted with an ordinary sprocket and chain drive. Among these may be mentioned the Thomas Auto-Bi, in which the motor is carried parallel with the bottom bar of the frame, and belt transmission is used, a half-round pulley being attached to the left-hand side of the rear

wheel. The tension of the belt is regulated by means of a vertically-adjustable idler, attached to the seat-post. This machine is manufactured by the E. R. Thomas Motor Company, of Buffalo, N. Y. The Auto-Bike built by the Holley Motor Company, Bradford, Pa., is another rear-driven motor cycle, which differs materially from the one just mentioned in having a very much longer wheel base. The motor is carried in the lower bifurcated half of the seat-post, and a chain drive, located on the left hand side of the wheel, is used, an ordinary chain gear actuated by the pedals being carried on the right hand side, as in the common bicycle.

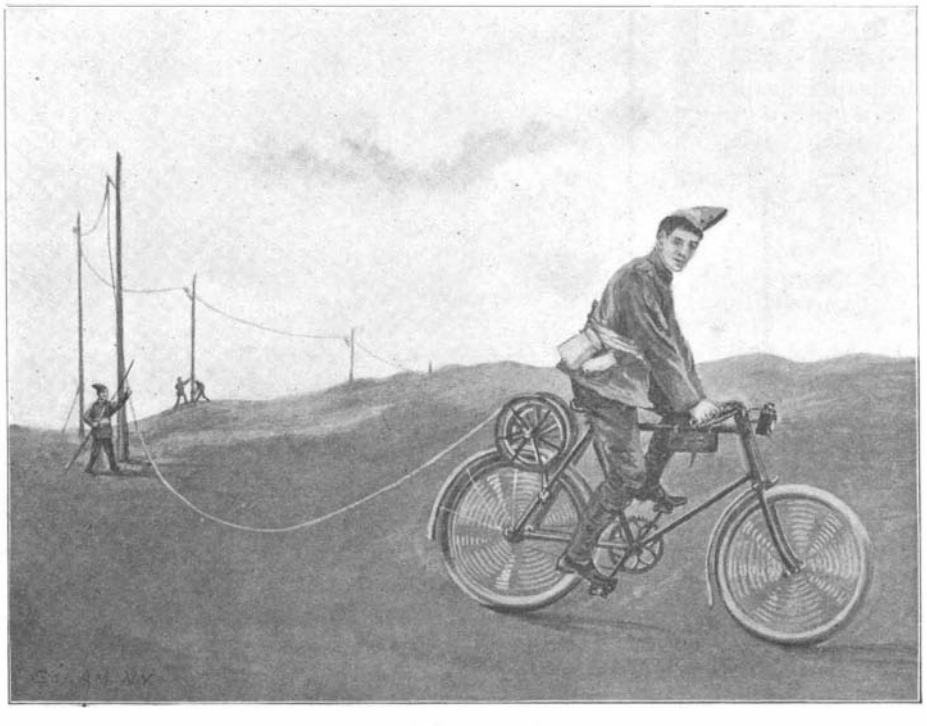
We present illustrations of an interesting type made by the Fleming Manufacturing Company, of this city. It differs from those already mentioned in the fact that the motor is carried upon a frame in front of the steering head, and that the drive is direct to the front wheel, power being transmitted by a five-eighths half-round leather belt which allows of much flexibility and large bearing surface. The belt is tightened by an adjustable ratchet lever, which allows the wheel to be started with the belt somewhat loose, the belt being tightened up after the wheel is in motion. There is an advantage in this arrangement in the fact that the momentum of the wheel and rider enables the motor to be started with ease without any extra exertion on the pedals. The connection with the battery is made by means of the left-hand grip. After the machine is started, the belt can be slackened somewhat by taking off the extra friction on the idler. The speed can be regulated by advancing or retarding the timing device, which changes the time of ignition in the cylinder. The speed can also be regulated by throttling the mixture before it enters the cylinder. The gasoline tank holds two quarts, which is sufficient for a continuous journey of from 50 to 60 miles. The tank is carried over the front wheel, but if desired an auxiliary tank is provided which is placed above the rear wheel of the machine and holds one gallon of gasoline. The frame which carries the motor forms practically part of a specially constructed front fork, and it is so designed as to materially add to the strength of the latter. Not merely the motor, but practically the whole of the motor equipment, is carried on the front forks, only the induction coil and battery being hung from the top tube of the bicycle frame. It is claimed that there is convenience in this form of construction, arising from the fact that a complete motor and front fork may be provided by the makers, which is capable of being attached to any good, strong bicycle frame, in any reputable repair shop, the only work necessary after assembling the front fork to the frame being to hang the coil and battery case to the frame, for which purpose clips are provided. The exhaust muffler is carried down in front of the supply tank, so as to insure warm gasoline at all times, and also insure that the burnt gases will be discharged below the forks, and as near the ground as possible.

ELECTRICAL ENGINEERS IN SOUTH AFRICA.

The war in South Africa brought electrical engineers into prominence by the rôle they played in many interesting military operations. The services of the electrical engineers were freely tendered and accepted and special equipment was gotten together and shipped. Traction engines, dynamos, arc and search lights, twenty bicycles provided with reels for paying out telephone wire, were among the things shipped by a transport. The first work after arrival was a temporary electric light installation on the Bethulie road bridge. Six arc lights were operated by current obtained from a dynamo driven by a traction engine. The field telephone was first put into use across this bridge. Field telephones were also used to maintain communication with the flying column, copper wire No. 22 B. W. G. being used. The freight yard and locomotive shops at Bloemfontein were lighted with arc and incandescent lamps. The work of the electrical engineers was of this general class, arc and incandescent lights were installed at many places, the search lights were used for various purposes, telegraphic communication was restored, and they also assisted in the work of repairing bridges, relaying track, etc. The engineers were also in a number of engagements, in which they showed that though volunteers, and volunteers of a special class, they were good soldiers as well.

When Pretoria was reached, there was plenty of work in fitting up electrical apparatus which had been wrecked by the Boers. Elaborate construction work was carried on at this city, and the authorities had the advantage of expert advice.

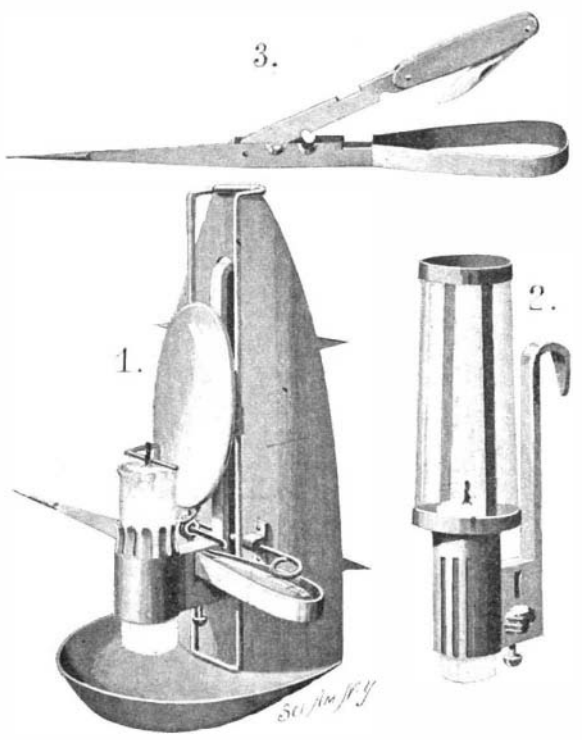
The reel shown in our engraving can be carried either on the frame of the machine or the back of the rider. Normally the wire was payed out directly on the ground, but for more permanent use posts were used.



PAYING OUT TELEPHONE WIRE IN SOUTH AFRICA.

A COMBINED MINER'S CANDLESTICK AND TOOL.

The invention which we illustrate in the three figures presented herewith is a combined miner's candlestick and tool devised by Charles H. Cornell and Felix J. Troughton, of Victor, Colo. In the invention a fuse-cutter, cap-primer, knife, fuse-splitter, hat-shield, reflector, and candle-holder are incorporated.



COMBINED TOOL AND MINER'S CANDLESTICK.

The candlestick comprises a shield, a drip-cup carried by the shield and a candle-holder mounted on a supporting bar, the upper hook end of which passes through an opening in the upper part of the shield. The supporting-bar is locked to the shield by a bent wire turning in suitable bearings. In an opening formed by the supporting-bar a tool is received (Fig. 3) which is held in place by a coiled spring and which comprises a body-bar pointed at one end and provided with a looped handle adjacent to which are parallel members. Each of these parallel members is provided with a recess designed to register with recesses in the cutting edge of a lever fulcrumed on the body bar so as to enter the space between the parallel members. The lever is provided with a clasp knife. The point of the body bar may be inserted in crevices, so that the lamp can be supported from the looped handle. The cutting edge of the lever serves the purpose of splitting a fuse; and the coacting recesses in the lever and body-bar doubly crimp the miner's caps. The uses of the knife are obvious.

On vertical guide-rods secured to the shield a slide is mounted, carrying a reflector and a bent wire which bears on and follows the candle as it burns away, thus serving to adjust the position of the slide relatively to the burning candle so that the reflector will always be located behind the flame. In connection with the candle-holder a chimney support is employed which has a tubular base made to slip over the candle-holder and its supporting bar. The tubular base carries a mica chimney (Fig. 2) which is detachably held between upper and lower clasp-rings connected by metal straps.

A Pneumatic Tube Service.

A complete and exhaustive expert investigation has been made into the cost, operation, etc., of the pneumatic tube postal service, with a view to determine whether the service should be owned, leased, extended, or discontinued by the government. The committee fully sustains the pneumatic method of mail transportation as a valuable and mechanically successful system, and in the great cities can no more be discarded than the fast mail train. For New York the joint committee discusses a proposition for the installation of eighteen miles of new line. The proposition involves the connection of twenty-one stations and the main office. The annual rental proposed is $398,500. The present service of 5.18 miles cost $167,100. There will, of course, be a large reduction of wagon service, elevated railway service and incidental savings, which are reckoned at $101,052. It is proposed to reduce the charge for special delivery if the service is extended. For Brooklyn 13.5 miles of new tubes are proposed with seven new connections at a cost of $172,097. All proposals included the continued operation of the existing system. The House Committee on Post Offices and Post Roads has completed its appropriation bill, but there is no provision for the continuance of the pneumatic tube service. This will probably be added later in the discussion of the bill.

Helen Keller Makes a Speech at Radcliffe College.

Helen Keller, who was once deaf, dumb and blind, can no longer claim the second infirmity. She recently made a speech at the freshmen's luncheon at Radcliffe College, Cambridge, in which she is a student. Her words were heard clearly throughout the hall, and her little speech was met with long and enthusiastic applause. She is now taking, besides history, French and German and an English course that includes daily themes. In the last course her productions are most remarkable. In the lectures Miss Sullivan translates to her what the lecturer says. This is all that is necessary, for it is not needful for her to take any notes. Her style shows great individuality.

The Current Supplement.

The first page article in the current Supplement, No. 1308, is devoted to "Recent Excavations in the Roman Forum," and is illustrated by engravings made from photographs obtained especially for the Supplement. "Archæology in the Past Century" is by Prof. Flinders Petrie, and is the commencement of a most important and interesting article by a great authority. "Saturn's Rings" is by Prof. Harold Jacoby, of Columbia University. "Meteorological Instruments" is by Prof. Hans Hartl, and is accompanied by a number of engravings. "Recent Science" is by Prince Kropotkin and is the second installment of this paper. "Anatomy and Physiology of Insects" is a lecture delivered at the Academy of Natural Sciences at Philadelphia by Dr. Henry Skinner. "Prehistoric Ostriches" is a curious article. "The Steam Turbine: Steam Engine of Maximum Simplicity and Highest Thermal Efficiency," by Prof. R. H. Thurston, is concluded in this issue, and is one of the most important articles on mechanical engineering which has appeared for a long time. "Dr. Pupin's Improvements in Long-Distance Telephony" is by Herbert T. Wade, and is referred to elsewhere. "New Wind-Recording Apparatus" describes some new instruments. The usual consular and trade notes are given.

Contents.

(Illustrated articles are marked with an asterisk.)